PRE-GHACOF 37 CAPACITY BUILDING TRAINING WORKSHOP AND REGIONAL CLIMATE MODELING TOWARDS JUNE- AUGUST 2014 FORECAST

IGAD Climate Prediction and Applications Centre
Nairobi, Kenya

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Report

By

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ACRONYMS

AfDB	Africa Development Bank
CBTW	Capacity Building Training Workshop
CCA	Canonical correlation analysis
COF	Climate Outlook Forum
DRR	Disaster Risk Reduction
ENSO	El Niño/Southern Oscillation
GHA	Greater Horn of Africa
GHACOF35	Thirty Fifth Greater Horn of Africa Climate Outlook Forum
GPCs	Global Producing Centres for Long Range Forecasts
ICPAC	IGAD Climate Prediction and Application Centre
IGAD	Inter-Governmental Authority on Development
IOD	Indian Ocean Dipole
KMA	Korea Meteorological Administration
LRF	Long Range Forecasts
MMEs	Multi-model ensembles
NMSs	National Meteorological Services
NWP	Numerical Weather Prediction Model
SOND2014	June to August 2014 rainfall season in the GHA
SOI	Southern Oscillation Index
SST	Sea surface temperature
SVD	Singular Value Decomposition
WMO	World Meteorological Organization

PREFACE

The IGAD Regional Climate Centre, ICPAC continues provide climate services in support of regional efforts towards resilience building against societal impacts of climate extremes such as drought and floods which severely impact on the socio-economic welfare GHA region. In striving to provide climate information products to guide contingence planning in critical sectors especially food security, water resources and disaster risk reduction, the climate service providers must be continuously trained and their skills updated to ensure that they can perform climate process diagnosis, predictive analysis and climate forecast modeling with application of the most recent operational concepts, skills and tools. To address this capacity need for National Meteorological Services of GHA countries and process the regional climate scenario for June to August 2014, ICPAC hosted the pre-COF 37 capacity building training workshop alongside regional climate modeling from 19th to 23th May 2014. The training workshop as well as the hands-on regional modeling was held within the auspices of African Development Bank (AfDB) regional support to ICPAC.

The core participants were climate scientists drawn from the National Meteorological Services of GHA countries in the northern sector, mainly Sudan, Ethiopia, South Sudan, Djibouti, and Kenya as well Rwanda and Burundi. I thank AfDB for the intuitional support, the permanent representatives of GHA member countries with WMO, the participants and facilitators for tireless training, thoughtful climate analysis and modeling work which was the most important input into the Thirty Seventh Greater Horn of Africa Climate Outlook Forum which was held in Khartoum from 25th to 26th May 2014.

Prof Laban A Ogallo,
Director, ICPAC

1.0 **Introduction**

The IGAD Climate Applications Centre continues to provide mandatory climate information services by real time monitoring and prediction activities for the whole of the Greater Horn of Africa (GHA). The climate scenario evolution for the next three months provides guidance information for planning and implementation of climate sensitive socio-economic activities at regional and national levels. Over the GHA region, climate extremes impact negatively on societies and adversely affect welfare beyond national boundaries. For example failure of seasonal rainfall impacts very adversely on individuals and communities with disasters like famine and water shortages, often leading to conflicts over diminishing resources. Proper planning to avert and cushion communities against these kind of climate driven disasters can only be supported by climate information provided well in advance of onset of adverse conditions. Thus climate stress and associated disasters is a major concern influencing socio-economic welfare of the GHA and ICPAC continues provide the regional climate information needs by carrying out and issuing real time climate monitoring, diagnosis and forecasts for socio-economic sectors, particularly agriculture/food security and water resources as critical sectors whose productivity is sensitive climatic conditions.

The Intergovernmental Authority on Development (IGAD) recognizes that consolidation of climate information has direct implications on regional socio-economic welfare and has a significant role in the realization of sustainable development and resilience building in the region. Adverse climatic extremes and conditions stress communities and governments across all the member states. More often than not, the impacts are negative to regional common good. It is these negative impacts which motivated the new IGAD strategy on climate extremes and change impacts, namely to build regional resilience against adverse impacts.

It is for this purpose that IGAD Climate Prediction and Applications Centre (ICPAC) organized a one week capacity building training workshop (CBWT) and regional climate modeling workshop towards regional climate forecast for the period June to August 2014. The hands-on workshop and regional climate modeling addressed processes and mechanisms which would be the most dominant drivers of regional climate

evolution during June to August 2014. Outputs of the workshop were the main inputs into GHACOF37 that was held in Grand Holiday Villa, Khartoum, Sudan from 25 - 26 May 2014.

1.2 Objectives

The objective of this capacity building training and regional climate modeling workshop (CBTW) was to carry out diagnosis and prognosis of the drivers of global, regional climate and local scale climate evolution, all with implications on the most plausible scenario during June – August 2014 season and to avail this information for use in resilience building against adverse impacts of climate extremes as support to climate smart development efforts, disaster risk reduction, Climate change adaptation and sustainable development.

Specific Objectives included:

i) To enhance the expertise of climate service providers of the national meteorological services (NMSs) of the ICPAC member states.

ii) To undertake diagnosis and modeling the global, regional and local scale processes and mechanisms with predictive linkage to the regional climate scenario during the season June – August 2014 over the whole of GHA.

iii) To provide the GHACOF37 consensus regional climate outlook for June – August 2014 to be used by applications sectors agriculture like food security, water resources, and disaster risk contingency planners inform their strategic activities during June to August 2014 season over the region.

1.3. Methodology

The training part of the pre-COF37 regional climate modeling and capacity building workshop involved each country participant preparing his country rainfall data templates for each climatological zone in their own countries for the June – August season during the 53 years analysis period 1961 to 2013. The participants were guided through data consistency checking, quality control and diagnosis analysis involving construction of anomalies and identification of major modes of interannual rainfall variability during June to August for each year over each zone.

The diagnosis analysis was followed by process based predictive modeling using linear and non-linear techniques as well as deterministic dynamical model and ensembles. Some of the predictors which were used in the statistical-probabilistic modeling included sea surface temperatures over Indian, Atlantic and Pacific Oceans and their evolving influence on regional rainfall temporal evolution patterns nearly average Indian Ocean dipole mode index (IOD), generally warmer equatorial Atlantic, and ENSO neutral with a weak Southern Oscillation Index (SOI).

All participants used these predictors to fit predictions models, test performance and use most skillful models to forecast the June to August 2014 rainfall over homogeneous climatological zones in each country. In cases where models were linear regression type, predictors were screened to eliminate redundancy and use only those predictors with physical association with rainfall in the homogeneous climatological zones. Care was taken to ensure that models used captured most of the extremes in observed rainfall during June – August season and that the predictors were consistent with conditions expected to persist through August 2014.

The prediction results for each country were supplemented by dynamical model ensembles using the set of 12 dynamical models from global producing centres (GPCs) outputs for June-August 2014 provided by the World Meteorological Organization (WMO) through the lead centre for standardization and multimodel ensemble post-processing hosted by the Korea Meteorological administration (KMA) through an on-line processing at the link. http://www.wmolc.org/. All participants were trained on how to select the dynamical model domain relevant to the country on interest as well as the whole region and post process the dynamical multimodel ensemble forecasts for June – August 2014 season.

Output of these methodologies provided the regional GHA consensus climate forecast for June-August 2014. This consensus climate forecast was the main information product used to drive activities during the Thirty Seventh Greater Horn of Africa Climate outlook Forum (GHACOF37) held at Grand Holiday Villa Hotel and Suites, Khartoum, Sudan from 25th to 26th May 2014.

2. Workshop presentations

Dr J N Mutemi highlighted the basis of both statistical and deterministic modeling for June to August 2014 climate prediction. He noted that interannual climate variability is strongly correlated to variability of ocean characteristics which impacts on the nature of atmospheric circulation, and thus rainfall distribution. Best example is the existence of sea surface temperature (SST) differences which directly derives atmospheric circulation cell with moist influence in land areas within the vicinity of warmer ocean and consequent drier conditions in the neighborhood of colder ocean areas. Thus SST influence is the basis of seasonal climate predictability and this is why SSTs are the main boundary forcing mechanism in dynamical models. The strongest manifestation of this signal is in the form of El Niño/ Southern Oscillation Index (ENSO) in the tropical Pacific which often has positive connection with western equatorial Indian ocean in form of the Indian Ocean Dipole Mode (IOD). SST differences in equatorial Indian Ocean with warmer than average conditions over the western sector and colder than average conditions over the eastern sector in form of Indian Ocean Dipole (IOD) is well correlated with atmospheric circulation which has positive impacts on rainfall in the equatorial sector of the GHA. Dr Mutemi concluded his presentation with demonstration of evolving patterns of tropical ocean SST anomalies and atmospheric circulation patterns at various levels of the atmosphere all with predictive implications on June – August 2014 rainfall the GHA region. Process evolutions up April 2014 indicated that ENSO neutral conditions are likely to dominate the climate system at least up to June 2014 beyond which conditions are predicted to shift towards weak El Nino like conditions. For the June to August 2014 period, the most significant driver of regional rainfall will therefore be regional scale processes alongside neutral ENSO conditions.

In his presentation, Dr C Oludhe illustrated to the participants step by step basics of statistical model fitting, verification and running of forecasts. Dr Oludhe informed the participants to ensure that predictors used have strong and explainable linkage with rainfall over each zone to ensure that models are physically consistent with major processes of rainfall during the target June – August 2014 season.

In his presentation, Dr W Gitau illustrated how to process baseline climatology and anomaly maps for each country and how to merge these country maps into regional

patterns. Regional patterns with processes similar to those prevailing during July/August 2014 were of special interest as analogues of the forecast being made.

In his presentation, Dr F Opijah took the participants through the process of post processing dynamical model and ensemble combinations using the dynamical model runs available through the WMO GPC lead centre.

The country participants used the skills demonstrated and guided by the resource persons to make country forecasts and eventually the consensus June – August 2014 forecast that was used in GHACOF35. **Annex 1** is a sample of participant presentations together with the regional forecast input to GHACOF37.

3. Conclusion, Recommendation and Way Forward

All the participants learned how perform verification of seasonal climate forecasts as well as perform diagnosis of the major extremes which characterize the June to August rainfall in the countries as well as the whole GHA region.

The forecast output produced by the pre-COF 37 capacity building and regional modeling indicated likelihood of near normal rainfall during June – August 2014 over norther sector of the GHA, with likelihood of above normal rainfall over Ethiopian highlands and most of the South Sudan.

The participants recommended that intraseasonal variability should be addressed in future capacity building and regional modeling in order to provide important climate attributes like most probable dates of onset, and succession of wet and dry events.

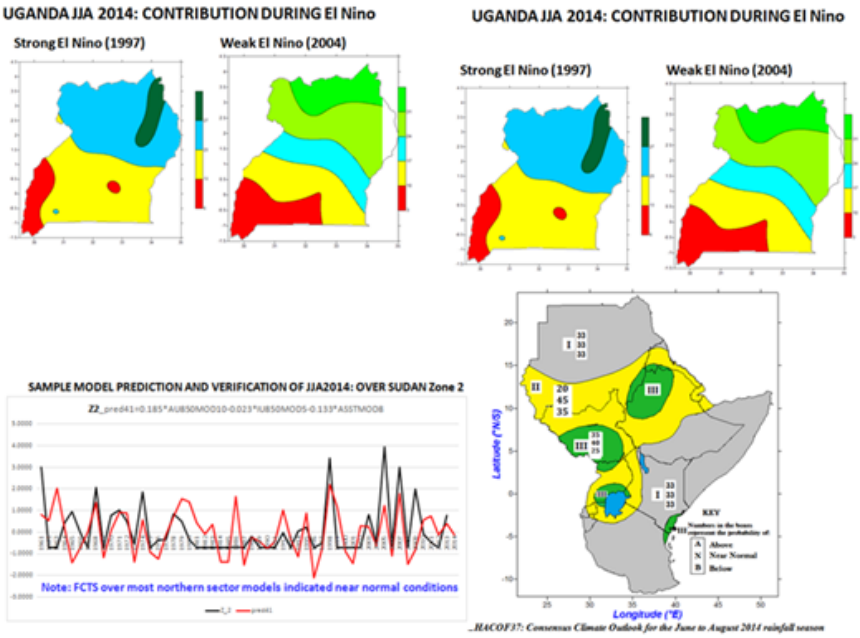
ICPAC member countries should avail daily station data, especially rainfall and temperature (minimum and maximum) so that regional user guides such as onset climatology maps can be generated.

Acknowledgements

The national focal point participants and resource experts expressed gratitude to the development partners of ICPAC, in particular African Development Bank (AdDB) for continued support to ICPAC, the PRs of the ICPAC member countries and to ICPAC director Prof L. A Ogallo for effective regional leadership in climate services. Participants thanked renowned organizations and institutions supporting operational

climate science services in the region, in particular the World Meteorological Organization (WMO), the National Oceanic and Atmospheric Administration (NOAA) and Korea Meteorological Agency (KMA) for value support to regional and national climate science data sets and suites of models.

ANNEX 1:
SAMPLE PRESENTATIONS FROM PARTICIPANTS OF pre-COF37 CBTW & REGIONAL MODELING



ANNEX 2: THE HANDS ON TRAINING PROGRAM

REGIONAL CLIMATE MODELING AND CAPACITY BUILDING TRAINING WORKSHOP (CBTW) FOR CLIMATE SCIENTISTS AND FORECASTING OF THE GHA CLIMATE DURING JUNE-AUGUST 2014. ICPAC: 18th – 27th MAY 2014

WEEK 1

TIME	SUNDAY 18th MAY. 2014	MONDAY 19th MAY. 2014	TUESDAY 20th MAY. 2014	WEDNESDAY 21st MAY. 2014	THURSDAY 22rd MAY. 2014	FRIDAY 23th MAY. 2014	SATURDAY 24th MAY. 2014
8.30 - 10.30	Arrival of participants	-Registration and opening ceremony: **Mr A Apuuli** on behalf of Director **Prof Ogallo** -Indicators and climate processes with linkage to GHA JJA 2014 climate scenario: **J Mutemi.** **Practical 1:** Generation and saving of country data templates by homogeneous zones - JJA rainfall series by country participants 1961 – 2013 **W. Gitau, B Mohamed, P Omondi**	**Practical 3**: Statistical-predictive modeling of JJA 2014 rainfall scenario over homogeneous zones in all countries -Model Fitting with identified predictors -Model Testing, screening and verification **-Preparation of Seminar 1** **J Mutemi, W. Gitau, C Oludhe, B Mohamed, P Omondi**	**Practical 4: Tune-up and finalization of statistical Modeling JJA2014 forecast results for all countries and regional pattern** **-Burundi, -Djibouti,-Ethiopia** **-Kenya, -Rwanda, -Somalia** **-South Sudan, -Sudan, -Uganda** **J Mutemi, B Mohamed, W Gitau, C Oludhe, P Omomndi**	**Practical 6:** **UK MET OFFICE JJA 2014 Model forecast and GHA Downscaling** **-A Colman (UK Met Office)** **-R Graham (UK Met Office)**	**SEMINAR 3** CONSENSUS GHAJJA2014 forecast finalization and verification -Country details -Transition Zones -Hot Spots, etc **All resource persons**	**MOVE TO GHACOF37 IN KHARTOUM, SUDAN** **NAIROB (Kenya) -➔ KHARTOUM (Sudan)**
10.30-11.00		**COFFEE**	**BREAK**	**COFFEE**	**BREAK**	**COFFEE**	
11.00-13.00	Arrival of participants	**Practical 1**: Continued ..1 **W. Gitau, B Mohamed, P Omondi**	**Practical 3**: Continued…1… **-Preparation of Seminar 1** **J Mutemi, W. Gitau, C Oludhe, , B Mohamed**	**Practical 5: Dynamical modelling, WMO GPCs and Regional Downscaling of Global Model Ensembles** -Model Output post-processing for JJA2014 rainfall and temperature -Skill indicators and basis for JJA2014 rainfall scenario **-F Opijah, B Mohamed, J Mutemi, R Graham (UK Met), A Colman (Uk Met)**	**Practical 6:** …Continued 1…. UK MET OFFICE…. **A Colman (UK Met Office)** **-R Graham (UK Met Office)**	SEMINAR 3…. Continued 1: REGIONAL FORECAST FINALIZATION -All resource persons	
13.00-14.00		**LUNCH**	**LUNCH**	**LUNCH**	**LUNCH**	**LUNCH**	DATES 25 - 27
14.00-15.30	Arrival of participants	**Practical 2**: Generation of JJA 2014 Indicators and Predictors -Recapping the statistical models and fundamental predictors to be used for JJA2014 -ENSO Indices focusing on likely neutral and/or weak El Nino during 2014 (NINO3, SOI, Oceanic heat-index, etc) -Tropical SSTs and SST modes over Indian and Atlantic Ocean indicators -Other indices: NAO, QBO. -Global and Regional scale circulation process indicators: Monsoons, Congo Air, Upper level systems including role of TEJ in JJA rainfall. **-P Omondi, B**	SEMINAR 1: JJA2014 **PRESENATION AND DISCUSSION OF STATISTICAL MODELING RESULTS** -Burundi, -Djibouti, -Ethiopia -Kenya, -Rwanda, -Somalia -South Sudan, -Sudan, -Uganda All Resource Persons	**Practical 5:** **…Continued…1…** Preparation of dynamical model JJA2014 forecast for each country and region **-F Opijah, J Mutemi, B Mohamed**	**Practical 7:** Statistical – dynamical Forecast merging and smoothing -Common attributes for regional consensus -Corrective adjustments for regional consensus -Draft 1 JJA2014 Outlook pattern **All resource persons**	**Documentation and wrap-up** Of HGA JJA2014 modeling and prediction work -Country report documentation -Regional Forecast documentation **J Mutemi, W. Gitau, C Oludhe, F Opijah, B Mohamed,**	**25th SUNDAY – 27th TUESDAY, MAY 2014 GHACOF37 IN KHARTOUM, SUDAN** **GHACOF37 PROGRAM IN KHARTOUM, SUDAN** (SEPARATE PROGRAM)

		Mohamed					
15.30-18.00		**COFFEE**	**BREAK**	**COFFEE**	**BREAK**	**COFFEE**	
18.00-19.30	Arrival of participants	**Practical 2**: …Continued 1….. **J Mutemi, B Mohamed, P Omondi**	SEMINAR 1 …... …Continued…. -Summary and action check-list for tune-up of statistical results for all countries **-J Mutemi, W Gitau, C Oludhe. P Omondi**	**Practical 5: …Continued…2…** -Documentation of dynamical model JJA2014 forecasts	SEMINAR 2: JJA2014 **Presentation and discussion of country and regional consensus JJA2014 forecast** **All resource persons**	**Documentation and wrap-up** -Report writing and submission of work templates and soft-copies -J Mutemi, B Mohamed	
20.00-23.00	**Arrival of participants**	**Documentation**	**Documentation**	**Documentation**	**Documentation**	**Documentation**	

Resource Persons: Prof L A. Ogallo, Dr J N Mutemi, Dr W Gitau, Dr C Oludhe, Dr P Omondi, Dr F. Opijah, Mr B Mohamed, Dr A Opere

ANNEX 3: LIST OF PARTICIPANTS

Names	Country	Organization
Paulino Omj Omay Deng	South Sudan	S. Sudan Met. Dept
Henock Hailu Misganaw	Ethiopia	National Meteorological Agency
Mwathi Anthony Musili	Kenya	ICPAC-MSC. Graduate Student
Misiani Herbert Omondi	Kenya	ICPAC-MSC. Graduate Student
Okoth Kabaka George	Kenya	ICPAC-PhD. Graduate Student
Harald Simiyu	Kenya	Kenya Meteorological Services
Otieno George	Kenya	ICPAC-PhD. Graduate Student
Sabiiti Geoffrey	Uganda	Makerere University, Uganda
Abdoulkarim Moussa Hassan	Djibout	Djibouti Meteorological Department
Juma Ali Mohammed Taradin	South Sudan	South Sudan Met.Department
Bekele Ejeta Fufa	Ethiopia	Ethiopia Met Agency
Nying'uro Achieng' Patricia	Kenya	Kenya Meteorological Services
Sebaziga Ndakize Joseph	Rwanda	Rwanda Met Dept & Post-Graduate Student, University of Nairobi
Lakemariam Yohannes Worku	Ethiopia	Ethiopia Met Agency
Omony George William	Ugand	Uganda Meteorological Department
Nshimirimana Godefroy	Burundi	Burundi Meteorological Services
Ouma Jully Odhiambo	Kenya	ICPAC-Postgraduate Research Student
Anyango Maureen	Kenya	ICPAC-MSC. Graduate Student
Mohamed Elsharif Mohamed Zain	Sudan	Sudan Meteorological Authority

ANNEX 4: LIST OF RESOURCE PERSONS

Names	Country	Organization
Prof L A Ogallo	Kenya	ICPAC
Dr J N Mutemi	Kenya	University of Nairobi
Dr A Opere	Kenya	University of Nairobi
Dr C Oludhe	Kenya	University of Nairobi
Dr W Gitau	Kenya	University of Nairobi
Dr P Omondi	Kenya	ICPAC
Dr F Opijah	Kenya	University of Nairobi
Mr B Mohamed	Sudan	ICPAC
Dr G Ouma	Kenya	University of Nairobi